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**ANCIENT INDIAN
KNOWLEDGE IN
CHEMISTRY**

SYSTEMATIC APPROACH IN SCIENCE

Na kramena vinaa saastram na saastrena vina krama: Sastram kramayutham jnathvaa ya: karoti sa siddhibhak

Without systematic approach there is no science, without science there is no systematic approach, one who knows that science is the systematic approach of learning and doing the work, he is known as the scientist/ expert

Rasaratna samucchaya 6/2

PHILOSOPHY OF SCIENTIFIC EXPLANATION

Nakhakrunthanena sarvam kaarshnaayasad vijnaatham...karshnaayasad ithyeva sathyam

When a nail cutter made of iron is explained (or known).. then one should know that iron itself is the essence and everything about iron is known (the metallurgical process and quality of iron is known)

TWO TYPES OF ZINC MINERALS

Rasako dvi vida prokto dardura kaaravellaka: dardura satva paate syaat oushadhe kaaravellaka:

There are two types of zinc minerals known as dardura (calamine) and kaaravellaka (smithsonite). Dardura is ideal for metal extraction and the other is good for medicinal use

Rasaratna samucchaya 2 -149

THREE TYPES OF ZINC MINERALS

Mrutthika gudapaashana bhedato rasaka sthridhaa Peethasthu mrutthikakaro mrutthika rasako vara: Guddabho madhyamo jneya: paashanabha: kanishtika:

There are three types of zinc minerals Mruthikabha (calamine, guddabha (zincite) and paashanabha (zinc blende). Among these minerals, the yellow coloured calamine is the best and guddabha is the medium grade and the paashanabha is the inferior grade

Rasarnavam 7/29

COLOUR AND NATURE OF MINERALS

Peethakaa thamrakaa thaamra peethakaa vaa bhumi prasthara dhaathavo. Bhinnaa neelarajeemantho mudga maasha krusara-varnaa vaa dadhi bhindu pinda chitraa harodraa hareethakee, padma patra saivalyakruth pleehaanavadya varnaa bhinnaschunchuvalukaa lekha bindu svasthikavantha sagulikaa archishmantha sthapyamaanaa na bhidyanthe bahuphena dhoomascha suvarnadhathava: pratheevaa paarthaaasthamra roopya vedhana

The colours of the ores of diffeen metals are yellow, mixed copperish yellow, some are power in nature having the colour of neela rajee flower, green gram, black gram, curd, turmeric, terminelia, leaf of lotus, spleen of animal, sand, jasmine bud, and seed of neem. Some ores , when heated remains the same and some ejects surf and smoke. Arthasastra 2 -30

COLOUR OF COPPER ORE

Bharika snigdho mruduscha prasthara dhathu bhumibhago vaa .Pingalo haritha paatalo lohitoo vaa thamradhatu

The copper ores are heavy, tawny, green (chalcopyrites) darkblue (malachite), yellowish tint (azurite) , pale red or red (native copper).

Artha sasthra 2/30

THE CHEMICAL KNOWN AS ANJANA

Souveeramanjanam proktham rasanjanamatha param Sthrotho anjam thadanyaccha pushpanchanakameva cha. Neelanchanam cha theshaam hi svaroopam iha varnyate

Souveeramanjanam is (antimony sulphide), rasanjanam (yellow oxide of mercury) stthrotho anjanam (different form of antimony sulphide)

neelanjanam (lead sulphide) pushpanjanam (zinc oxide), these anjanas are explained here.

Rasaratna samucchaya 3/98

CALCIUM CARBONATE

Peethaabhaa granthikaa prushte deergha vruttha varatikaa. Rasavaidyair vinidishtaa saa charachara samjnika. Saardha nishkabharaa sreshtaa nishkabharaa cha mdhyamaa Paadona nishkabharaa cha kanishtaa parikeerthithaa

The calcium carbonate which has the elliptical shape and yellow colour is known as charachara varatika. (depending upon their size and shape) they are clasified as the saardha nishkabhara, which is the best, nishkabharaa the second grade and padona nishkabhara (low grade) Rasaratna samucchayam: 3/130-131

MERCURY DISTILLATION

Darada: paathanaa yanthere paatithascha jalaasraye. Thathsatvam sootha sankaasam jaayate naathra samsaya:

Darada: (cinnabar), the ore of mercury, when distilled in a distillation equipment and the vapors when condensed with water, gives the essence of the darada which is the mercury

Rasaratna samucchayam 3/144

EXPLANATION ON THE CORROSION

Suvarnam rajatham thaamram theekshanam vangam bhujangakam. Lohantru shadvidham thaccha yathaapoorvam thadakshayam,

Metals are classified under the class of gold, silver, copper, iron, lead and zinc. The resistance towards corrosion is in the reverse of the above order (the reactivity increases in the above order)

Rasaarnavam 7/97

FLAME TEST

Aavarta maane kanake peethaa thaare sithaa prabha Sulbe neelanibhaa theekshne krishna varnaa suresvaree Vange jvaalaa kaphothaabhaa nage malinadhoomakaa Saile thu dhusaraa devee aayase kapila prabhaa Ayaskaanthe dhoomra varnaa sasyake l;ohithaa bhaveth Vajre nanaavidhaa jvaala kha sathve panduraprabhaa

The colour of the flame can be explained as follows for gold: yellow, silver : white, copper : blue, wrought iron : blackish, tin: pigeon colour (ash) zinc: dirty +smoky colour, silicon : white, iron : blackish, iron oxide : brownish, mercury : reddish and diamond : variety of colour and mica : white colour

Rasarnavam 4/51

THREE TYPES OF IRON

Mundam, theekshnam cha kaantham cha triprakaram ayasmrutha:

There are three types of iron cast iron (munda loha, wrought iron (theekshana loha) and carbon steel (kaantha loha)

Rasaratna samucchaya 5/69

ALPHA AND BETA TIN

Khurakam misrakam cheti dvividham vangam-uchyate Khurakam thathra gunai: sreshtam misrakam na hitam matham dhavalam mrudulam snigdham druthadraavam sagouravam nissabdam khuravangam syaan misrakam syaama subhrakam

There are two types of tin known as khurkam (beta tin) and misrakam (alpha tin) the beta tin is better in quality and the other one is of low grade and the former is white, soft flexible, low melting, denser and without metallic sound and the misrakam is blackish white in colour and said to be not acceptable

Rasaratna samucchayam 5/153-154

EXPLANATION OF LEAD

Drutha draavam mahabharam cchede krishna samujvalam poothi gandham bahi Krishnam suddham seesam athoanyathaa

Lead is dense metal having low melting point, when cut, the surface gives black lustre. It has obnoxious odour and black in colour, when exposed to air

Rasaratna samucchayam 5/170

EXPLANATION OF ZINC METAL

Cchede samujjvalam snigdham mrudulam nirmalam thathaa drutha draavam mahabharam yasadam grahyamuchyathe

The zinc metal has shining moistened lustre when cut. It is soft in physical nature, pure in look having low melting point and denser

Rasatharangini 19/95

ALPHA & BETA BRASS

Reethikaa kaakathundeethi dvividam pitthalam bhaveth Santhaptha kaanchike kshiptaa thamraabhaa reetikaa matha. Evam prajaayate krishnaa kaakathundeeti saa mathaa

There are two types of brass : reethikaa and kaakathundee. When dipped in the boiled rice gruel, the reethika type brass gives copper colour and the other one gives black colour

Rasendra choodaamani 14/154

BRONZE

Ashtabhagena thaamrena dvibhaga khurakena cha

Vidruthena bhavelkamsyam thathsourashtrabhavam subham

When eight parts by wieght of coper is alloyed with two parts by weight of tin, the bronze is obtained, the brone produced in Sourashtra is said to be best in quality

Rasaratna samucchayam 5/205

EXPLANATION OF A LABORATORY

Aathanka rahite dese dharmarajye manorame
 Umamahesvaropethe samruddhe nagare subhe
 Karthavyam saadhanam thathra rasaraajasya dheemathaa
 Athyantha upavane ramye chathur dvaaropasobhithe
 Thatre saala prakrthavyaa suvistheerna manoramaa
 Samyagvaathaayanopethaa divya chithrairvichithrithaa
 Thathsameepe same deepthe karthavyam rasamandapam
 Athiguptham suvistheernam kapaatargala sobhitham
 Dhvaja cchathra vithaanadyam pushpa maalaa vilambitham
 Bheri kaahala ghandaadi srungeenada vinaditham
 Bhu: samaa thathra karthavyaa sudhudaa darpanopamaa
 Thanmadhye vedikaa ramyaa karthavyaa lakhnanvithaa

The laboratory shold be constructed in a bearutiful and developed twon. In the twon there should the temple of Umamahesvara. With the wisdom of the king who has knowledge on the chemistry, the laboratory having four gates should be established in the centre of a garden or valley. The laboratory should be spacious and beautiful. It should have enough ventillation and also many pictures for decoration. The working table should be constructed where enough light will be availble. The whole set up should be spacious and also having enough protection.

In front of the laboratory, there should be a flag, and also decoration with flowers. Music should be played in the laboratory. All the floors of the laboratory should be hard and clean as mirrors. All these should be highly attractive

Rasaratna samucchayam 6/11 -16

CHEMISTRY RESEARCH SCHOLAR

Gurbhakthaa sadaacharaa sathyavantho drudavrathaa
Niraalasyaa svadharmajnnaa sada aajnaapareepalakaa
Dambha matsarya nirmukthaa kulaa aachareshu deekshithaa
Athyantha saadhakaa santhaa manthra araadhana thalparaa:
Ithyevam lakshanair yuktham sishya: syu: soothasiddhaye

The best chemistry scholar is the student who respects his supervising teacher, who is loyal, truthful, sincere, active, duty bound and obedient. He should be free from false ego and jealousy and should be stable in approach, noble in behaviour, calm in nature and enterprising in character.

LABORATORY ASSISTANT

Sahaayaa: so udymaasthathra thathaa sishyasthatho adhikaa:
Kuleenaa: svami bhakthaascha karthavyaa rasakarmani
Rasaratna samuchaya 6/7

A laboratory assistant should be very active, more efficient than the students/ scholars born in a noble family and highly obedient, and devoted in undertaking the chemical based works

Rasaratna samuchya 6/6

LABORATORY APPARATUS

1. dolayanthra 2. Svedana yantra 3 paathana yantra

4. Adha paathana yantra 5. Kacchapayantram

6. deepikaayantram 7. jaaranayantram.....

Rasaratna samuccayam 9/1-3

CRUCIBLES/MUSHA

Vajra musha - yogamusha - vajradravini musha - gaara musha - vara musha - varna musha - roupya musha - bida musha --

FURNACE - KOSHTI

Sathvaanaam pathanaarthaya paathithaanaam visuddhaye

Koshtika vividhakaarasthaasaam lakshnamuchyathe

For the production of the metals/materials and also for the purification of the materials different types of furnaces are used. Their size and shapes are explained

Rasaratna samuccayam 10/31

A SPECIAL METAL USED FOR MEASURING UV & VISIBLE RAYS

Athaanjaneka dasakam dhoumya dvaadasakam thathaa

Neelanjanam shodasamsam charvimsamsakam ruro:

Jamvalikasthi dasakam sarkarashkameva cha

Churdasamsam suthasya navamsam gairkasya cha

Varatikaa pachakam cha thatthath bhagaanusaaratha:

Ethan samyojya mushayaam sampoorya vidhivath kramath

Shadvimsamathyutthara panchasatha kakshyoshnamaanatha:

Gaalayithvaatha yantraasye sechayeth adhivegatha:

Cchayaa prabhavibhjkaka lohasyaal kruthaka sthatha:

Yanthra sarvaswam of Bharadvaja mahashi (109 th yantra)

Graphite (anjaneekam) 10 parts, ammonium chloride (dhaumya) 12 parts, antimony sulphide (nilanjana) 16 parts, ash of the bones of deer (ruruka) 16 parts, ash of jambalika animal (jambalika kshara) 10 parts, silicon dioxide (sarakara) 9 parts, mercury (suta) 5 parts, ferric oxide (gairika) 9 parts calcium carbonate 5 parts are mixed and heated to 526 degree to get the cchayaprabhavibhajaka loha.

SOME OF THE SANSKRIT WORDS FOR CHEMICALS

Khacharakhya loha....kha = sky, chara = moving, akhya connected loha = metal (quartz/silicon dioxide)

Bhuchakra suramitadi kshara ... bhu: = earth chadra = circle/coiled, suramitra = vishnu kshara = ash (ash of saligramam)

Ayaskantha = magnetic ore of iron

Ruruka = young deer (assumed that it is bone ash of young deer)

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